

REMARKS

By this Amendment, Claims 25, 31, 41 and 45 are amended leaving Claims 25 and 28-45 pending in the application for the Examiner's review and consideration.

Claim 25 has been amended to recite gas outlets being sized to inject the process gas at a sonic or supersonic velocity. Claim 31 has been amended to recite that the gas outlets include a plurality of angled gas outlets which inject process gas at an acute angle relative to a plane parallel to the distal end surface. Support for this change can be found at page 12, lines 20-27 of the specification. Claim 41 has been rewritten in independent form with a clarifying amendment which defines the central bore as defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall. Support for this change can be found in Figure 3a. Claim 45 has been amended to depend from Claim 28. As no new matter has been added, these changes should be entered at this time.

First Rejection

Claims 25, 29, 33-34, 37-38, 42 and 45 stand rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 5,685,942 to Ishii ("Ishii") in view of U.S. Patent No. 5,772,771 to Li et al. ("Li"). The reasons for the rejection are set forth on pages 2-4 of the Official Action. This rejection is respectfully traversed.

Claim 25 recites a gas injector for supplying process gas to a plasma processing chamber comprising a gas injector body sized to extend through a chamber wall of the processing chamber such that a planar axial distal end surface of the gas injector body is exposed within the processing chamber, the gas injector body including a plurality of gas outlets adapted to supply process gas into the processing chamber, wherein the gas outlets are located in the axial distal end

surface of the gas injector body and the gas outlets being sized to inject the process gas at a sonic or supersonic velocity.

As set forth below, the combination of Ishii and Li fails to teach or reasonably suggest all of the claim limitations.

To establish *prima facie* obviousness of a claimed invention, all the claimed limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 USPQ 580 (CCPA 1974). Independent Claim 25 recites, *inter alia*, a gas injector comprising gas outlets being sized to inject the process gas at sonic or supersonic velocity. As made of record at page 6 of the Official Action, "Ishii and Li...do not teach a gas injector for supplying process gas at sonic velocity." Furthermore, Applicants submit that any modification of Ishii to inject process gas at sonic or supersonic velocity would go against the teachings of Ishii, i.e., Ishii discloses a showerhead which supplies process gas at "much less than sonic" velocity.¹ Thus, the combination of Ishii and Li fails to suggest a gas injector for supplying process gas at a sonic or supersonic velocity. Accordingly, because the combination of Ishii and Li fails to teach or suggest all the claim limitations, Claim 25 is deemed patentable. Claims 29, 33-34, 37-38, 42 and 45 are deemed patentable based on their dependency from Claim 25. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Withdrawal of the rejection is respectfully requested.

Second Rejection

Claims 28, 30-32, 35,-36, 39-40 and 43-44 stand rejected under 35 U.S.C. 103(a) over Ishii and Li in view of U.S. Patent No. 6,013,155 to McMillin et al.

¹ At trans-sonic gas velocities, severe print-through effects occur. See U.S. Patent No. 4,612,077.

("McMillin"). The reasons for the rejection are set forth at pages 4-6 of the Official Action. This rejection should be withdrawn because the McMillin patent is not available as a reference against the present application.

The McMillin patent issued on January 11, 2000, which is after the December 30, 1998 effective filing date of this application. The McMillin patent was filed on June 30, 1997, but claims the benefit of a June 28, 1996 filing date. Thus, the McMillin patent qualifies as prior art only under 35 U.S.C. 102(e). However, According to MPEP §706.02(I)(2), with respect to rejections under 35 U.S.C. § 103(c) the McMillin patent can be disqualified as a prior art reference upon a showing of common ownership at the time the invention was made. Accordingly, Applicants provide the following statement.

Statement of Common Ownership

U.S. Patent Application No. 09/788,365 (the '365 application) and U.S. Patent No. 6,013,155 were, at the time the invention of the '365 application was made, owned by Lam Research Corporation.

Because the McMillin patent is no longer available as prior art against the application, Applicants respectfully request withdrawal of this rejection.

Third Rejection

Claims 28, 30-32, 35-36, 39-40 and 43-44 stand rejected under 35 U.S.C. § 103(a) over Ishii and Li in view of U.S. Patent No. 6,077,357 to Rossman et al. ("Rossman"). The reasons for the rejection are set forth on pages 6-7 of the Official Action. The Official Action alleges that while Ishii and Li fail to disclose a first O-ring seal, a second O-ring seal and a gas injector for supplying process gas at sonic velocity, it would have been obvious in view of Rossman to add these features to the gas injector body of Ishii. This rejection is respectfully traversed.

As noted in the Official Action, Ishii and Li fail to disclose or suggest a gas injector for supplying process gas at sonic velocity. Independent Claim 25, from which Claims 28, 30-32, 35-36 and 43-44 depend, recites, *inter alia*, a gas injector comprising gas outlets being sized to inject the process gas at a sonic or supersonic velocity. Rossman fails to cure the deficiencies of Ishii and Li as applied to Claim 25.

The Official Action at page 7 alleges that Rossman provides the motivation to inject process gas through the Ishii showerhead at sonic velocity because Rossman discloses providing for "vacuum integrity" and that "motivation for Ishii to optimize the flow [of the] process gas to sonic velocity is for increasing processing throughput." Applicants respectfully disagree with these assertions.

As recited at page 15, lines 22-23 of the specification, "[i]njecting the process gas at sonic velocity inhibits the plasma from penetrating the gas outlets." Rossman fails to disclose or suggest injecting process gas at sonic velocities. Applicants submit that there is no tenable relationship between providing for vacuum integrity and flowing process gases at a sonic or supersonic velocity.

Furthermore, the Official Action acknowledges that Ishii fails to teach a gas injector for supplying process gas at a sonic velocity. Applicants submit that Ishii does not disclose or suggest a gas injector for supplying process gas at a sonic or supersonic velocity. The Official Action, citing MPEP §2144.05, asserts that it would have been obvious to optimize the operation of the claimed invention. However, referring to MPEP §2144.05, before the determination of the optimum or workable ranges of a variable might be characterized as routine experimentation, a particular parameter must first be recognized as a result-effective variable, i.e., a variable

which achieves a recognized result. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).

Ishii discloses a ground electrode (85) having a hollow portion (86) formed in the electrode with a plurality of supply ports (87) leading to the hollow portion such that the supply ports are formed radially or coaxially below the hollow portion (see Ishii at column 8, lines 6-15). Ishii discloses that the supply ports are not necessarily the same diameter (Ishii at column 8, lines 40-41). However, there is no suggestion in Ishii to size the gas outlets in order to inject the process gas at a sonic or supersonic velocity as claimed.

Claim 28, which depends from Claim 25, recites a gas injector comprising gas outlets located in the axial distal end surface of the injector, the gas outlets include a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction.

Independent Claim 39 recites a gas injector comprising gas outlets including a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction, wherein the gas outlets are located in the axial distal end surface of the gas injector body, an annular flange adapted to overlie and contact an outer surface of the chamber wall; and a first O-ring in a surface of the flange for sealing against the outer surface of the chamber wall. For at least the reasons that follow, the combination of Ishii, Li and Rossman fails to suggest all the claim limitations.

The Official Action acknowledges that Ishii does not teach a plurality of angled gas outlets extending at an acute angle to the axial direction but alleges that it would

have been obvious to change the angle of a plurality of the gas outlets of Ishii because Li teaches a plurality of angled gas outlets.

Ishii discloses only ports that are parallel to each other (see Ishii at column 8, lines 10-15 and Figure 4). Li discloses multiple nozzles 56a where each nozzle 56a has an orifice 64 at its distal end, i.e., an orifice is located at the distal end of each nozzle such that the nozzles are not parallel to each other (see Li at column 3, lines 62-65; column 5, lines 19-28 and Figures 1 and 1A). Li provides no motivation to change the angle of a plurality of the gas outlets of Ishii while leaving unchanged a center, axial gas outlet. Neither Ishii nor Li suggest a gas injector having both a center gas outlet extending in the axial direction and a plurality of angled gas outlets extending at an acute angle to the axial direction wherein the gas outlets are located in the axial distal end surface of the gas injector, as recited in Claims 28 and 39.

The Official Action acknowledges that "Ishii and Li do not teach a first O-ring seal in a surface of the flange for sealing against the outer surface of the chamber wall." The Official Action alleges that "Rossman teaches a gas injection nozzle including a first O-ring seal in a surface of the flange for sealing against the outer surface of the chamber wall" (emphasis added). Applicants disagree. Rossman discloses "a Teflon seal 326 disposed inwardly of the channel in a recess 328" and not a seal for sealing against the outer surface of the chamber wall as recited in Claim 39 (see Rossman at column 17, lines 41-56 and Figure 14). Furthermore, Rossman does not disclose a gas injector having an annular flange adapted to overlie and contact an outer surface of the chamber wall as recited in Claim 39. The nozzles 302, 304 of Rossman are intended to be threaded in an inner chamber surface and thus teach away from an injector having an annular flange adapted to

overlie and contact an outer surface of the chamber wall. Withdrawal of the rejection is requested.

Fourth Rejection

Claim 41 stands rejected under 35 U.S.C. § 103(a) over Ishii and Li in view of U.S. Patent No. 5,734,143 to Kawase et al. ("Kawase"). The reasons for the rejection are set forth on pages 7-8 of the Official Action. The Official Action alleges that it would have been obvious to replace the injector body of Ishii with the injector body of Kawase. This rejection is respectfully traversed.

Claim 41 recites, *inter alia*, a gas injector body including a uniform diameter central bore extending axially from an upper axial end face of the gas injector body, the central bore being defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall, inlets of the gas outlets being located on the flat endwall.

Initially, Claim 41 depends from Claim 25 and thus is patentable over Ishii, Li and Kawase for at least the reasons that Claim 25 is patentable over Ishii and Li. Kawase discloses a heat resistant dielectric plate 11 having a plurality of gas injection holes 10. The plate comprises a waveguide axis 70. However, the waveguide axis (central bore) is not defined by a cylindrical sidewall and a flat endwall extending between the cylindrical sidewall as claimed. Moreover, in the dielectric plate of Kawase, the inlets of the gas outlets are not located on the flat endwall. Withdrawal of the rejection is requested.

It is submitted that the difference between the claimed subject matter and the prior art are such that the claimed subject matter, as a whole, would not have been


obvious at the time the invention was made to a person having ordinary skill in the art.

In view of the foregoing, it is submitted that the present application is in condition for allowance and such action is earnestly solicited.

Respectfully submitted,

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